CLAIMS

1. A sonic actuator comprising:

a multi-layer membrane including

a non-metallic elastomeric dielectric polymer layer having a first surface and a second surface;

a first compliant electrode layer contacting said first surface; and

a second compliant electrode layer contacting said second surface; and

a support structure in contact with said sonic actuator film.

2. A sonic actuator as recited in claim 1 wherein said non-metallic dielectric polymer is selected from the group consisting essentially of silicone, fluorosilicone, fluoroelastomer, natural rubber, polybutadiene, nitrile rubber, isoprene, and ethylene propylene diene.

3. A sonic actuator as recited in claim 1 wherein said compliant electrode layer is made from the group consisting essentially of graphite, carbon, conductive polymers, and thin metal films.

4. A sonic actuator as recited in claim 1 wherein said support structure is a grid having a plurality of apertures.

5. A sonic actuator as recited in claim 4 wherein said multi-layer membrane is biased such that portions of said film bulge at at least some of said apertures.

6. A sonic actuator as recited in claim 5 wherein said multi-layer membrane is biased such that portions of said film bulge in a first direction at at least some of said apertures.

7. A sonic actuator as recited in claim 5 wherein said multi-layer membrane is biased such that portions of said film bulge in a first direction at some of said apertures and such that portions of said film bulge in a second direction at others of said apertures.

8. A sonic actuator as recited in claim 6 wherein said film is biased by a gaseous pressure that is greater than atmospheric pressure.

9. A sonic actuator as recited in claim 6 wherein said film is biased by a gaseous pressure that is less than atmospheric pressure.

10. A sonic actuator as recited in claim 6 wherein said film is biased by a soft foam material.

11. A sonic actuator as recited in claim 10 wherein said soft foam material is a closed-cell foam with an average cell diameter substantially less than a diameter of said apertures.

12. A sonic actuator as recited in claim 7 wherein said film is biased by a gaseous pressure that is greater than atmospheric pressure where said film is bulging in a first direction, and is biased by a gaseous pressure that is less than atmospheric pressure where said film is bulging in a second direction.

13. A sonic actuator as recited in claim 5 wherein said support structure is substantially planar proximate to said apertures and wherein said bulging portion of said film exhibit an out-of-plane deflection.

14. A sonic actuator as recited in claim 1 wherein said multi-layer membrane comprises a sandwich structure having a plurality of layers of non-metallic elastomeric dielectric polymers alternating with a plurality of layers of compliant electrodes.

15. A sonic actuator as recited in claim 1 further comprising a square root driver coupled to said first compliant electrode and to said second compliant electrode.

16. A sonic actuator as recited in claim 15 wherein said square root driver includes a summer adding a low power input signal to an offset voltage and a square root generator coupled to an output of said summer.

17. A sonic actuator as recited in claim 16 further comprising a filter coupled to an output of said square root generator.

18. A sonic actuator as recited in claim 17 further comprising an amplifier coupled to an output of said filter to provide a signal to drive said multi-layer membrane.